Fort Future Utility Systems Tools

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Executive Summary

Utility systems "enable" most activities on military installations. Utility service disruptions and insufficient system capacity can adversely affect the military mission. Contamination of water or fuel supplies threatens health, safety, and mission.

The Fort Future Virtual Installation™ provides integrated tools that analyze the reliability, capacity, and vulnerability of utility systems and their relationships with installation missions.

Background

Problems with Utility Systems Can Adversely Affect the Mission

Mission-critical activities on military installations, such as training and force projection, rely on safe and reliable utility service. The sudden disruption of utility services or contamination of a water supply puts mission accomplishment at risk, endangers health, safety, and property, and significantly delays time-critical activities.

It is easy to assume that electricity, water, transportation fuel, communications, heating, and cooling will always be available when needed. Unfortunately, interruptions in utility service can be caused by acts of sabotage, terrorism, or vandalism as well as accidents, weather, or system component failures. Another threat is the introduction of chemical or biological contaminants into water or fuel supplies. Backup systems (such as generators) are available for many mission-critical activities, but they take time to implement, are costly, and are not always reliable.

Capacity is another issue that affects the quality and reliability of utility service. The Army Transformation will bring new missions, more troops, and new technology to installations. This will increase the demand for utility services and could overwhelm existing systems, especially during surge or emergency conditions. Inadequate capacity can result in problems such as power brown and blackouts and inability to fight fires.

The situation is complicated by the interdependency of utility systems; a failure in one system can cause a "cascade" of failures in others. For example, the massive 2003 power failure in the northeastern United States also interrupted the supply of water in many areas.

Technical Problem

Shortcomings in Current Methods for Evaluating Utility Reliability, Capacity, and Vulnerability

It is difficult to quickly and effectively evaluate the reliability, capacity, and vulnerability of utility systems and their relationships with mission activities at military installations.

Currently available methods and tools have several shortcomings. No tool shows the impact of utilities on mission. Most methods do not consider the interdependencies between utility systems. Methods that rely on utility modeling software tend to be targeted toward users with engineering backgrounds. These do not provide results that are clear to a non-technical person. Methods that do not use utility modeling software tend to be subjective.

Capability Development

Integrated Simulations Allow Quantitative Analysis of Utility System Impact on Mission Activities

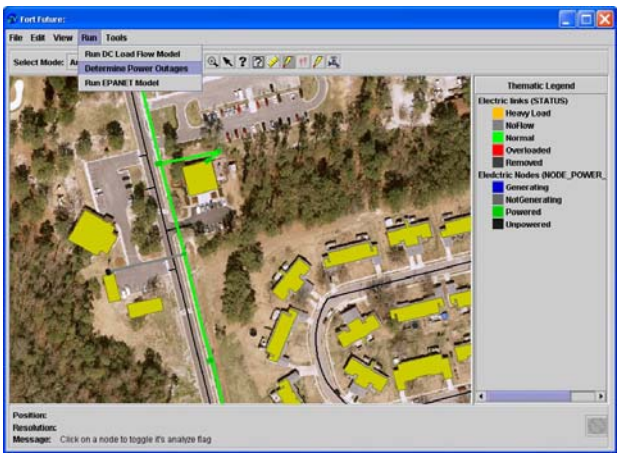
The Fort Future Virtual Installation™ (VI) integrates utility system simulations together and with a resource contention process model. Results from utility simulations show operating data, such as flow rates and pressures in water systems and voltages and currents in electrical systems. The

VI incorporates “rules of thumb” (heuristics) to interpret simulation results in the context of the question at hand. The user does not need technical or engineering expertise to understand what the results mean.

The VI can be used to address a wide variety of issues relating to utility system capacity and vulnerability. Some questions a user could address include:

- Is capacity sufficient to supply this new facility or mission?
- Can multiple contingencies be addressed by the utility system (e.g., supplying firefighting water to multiple hydrants)?
- Which facilities lose electricity if this power line fails?
- Which facilities lose water if this electrical substation fails, and what is the impact on our firefighting capability?
- What areas would be affected if a waterborne contaminant was introduced at this location? How long would the system be affected?
- Which utility components are most critical for supplying the utility to the installation?
- What would be the impact on the mission if certain network components failed?

The combined utility model is further integrated with a resource contention process model. The process model within the VI allows a series of activities, such as deployment preparations or manufacturing, to be correlated with the infrastructure and simulated. The utility models can be used during the process simulation to evaluate activities



that put demands on utility systems, such as motorpool operations involving cranes (high electrical demand), or wash facilities (high water requirements). For example, the utility model used during a deployment simulation can evaluate how the loss of power impacts the ability to deploy.

The VI is built on a Geographic Information System (GIS) platform. Existing data from installations, in standard formats, is used to create the layers of the VI, including the utility systems. Process models represent actions that can be tailored to specific installation requirements. Thus, expensive, redundant data entry is minimized.

Status

The capability to simulate water and electrical distribution systems is available today. Connecting the electrical system, water system, and process modeling capability will be completed soon. The addition of natural gas and transportation fuel system simulations is under development in FY05. Other utility system models are being considered for inclusion in FY06 and beyond.

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